

CALIBRATION STANDARD SPECIFICATION
FOR AN
ULTRASONIC FLOWMETER
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PROCUREMENT PACKAGE

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CALIBRATION STANDARD SPECIFICATION FOR AN
ULTRASONIC FLOWMETER

1. SCOPE

1.1 Scope. This specification defines the mechanical, electrical, and electronic characteristics for an Ultrasonic Flowmeter. This equipment is intended to be used by Navy personnel in shipboard and shorebased laboratories to calibrate or to assist in the calibration of flow meters. For the purposes of this specification, the Ultrasonic Flowmeter be referred to as the UF.

2. APPLICABLE DOCUMENTS

2.1 Controlling Specifications. MIL-T-28800, "Military Specification, Test Equipment for use with Electrical and Electronic Equipment, General specification for," and all documents referenced therein of the issues in effect on the date of this solicitation shall form a part of this specification.

3. REQUIREMENTS

3.1 General. The UF shall conform to the Type II, Class 3, Style D requirements as specified in MIL-T-28800 for Navy shipboard and shorebased use as modified below. The use of material restricted for Navy use shall be governed by MIL-T-28800.

3.1.1 Design and Construction. The UF design and construction shall meet the requirements of MIL-T-28800 for Type II equipment.

3.1.2 Power requirements. The UF shall operate on internal or external power as specified below.

3.1.2.1 DC Internal Power Source. The UF shall be capable of operation from rechargeable self-contained batteries as specified in MIL-T-28800.

3.1.2.1.1 Battery Life. The UF shall be capable of operation on battery power for at least one hour without recharging.

3.1.2.2 AC Voltage Power Requirement. The UF shall operate from a source of 103.5V to 126.5V at 50 and 60 Hz +/-5% single-phase, input power as specified in MIL-T-28800.

3.1.2.1 Fuses or Circuit Breakers. Fuses or circuit breakers shall be provided. If circuit breakers are used, both sides of the power source shall be automatically disconnected from the equipment in the event of excessive current. If fuses are used, only the line side of the input power line, as defined by MIL-C-28777, shall be fused. Fuses or circuit breakers shall be readily accessible.

3.1.2.2 Power Connection. The requirements for power source connections shall be in accordance with MIL-T-28800 with a 6-foot minimum length cord.

3.1.3 Dimensions and Weight. Maximum dimensions shall not exceed 11 inches in width, 17 inches in height, and 9 inches in depth. The UF weight shall not exceed 20 pounds.

3.1.3.1 Transducer Dimensions. The transducer's dimensions for the UF shall not exceed 1.5 inches in width, 6 inches in height, and 5 inches in length.

3.1.3.2 Transducer Mounting. The UF's transducers must be capable of being mounted with the aid of a rack or track to assure proper mounting. The racks or tracks shall have indications of transducer positions within the racks or tracks.

3.1.4 Lithium Batteries. Per MIL-T-28800, lithium batteries are prohibited without prior authorization. A request for approval for the use of lithium batteries, including those encapsulated in integrated circuits, shall be submitted to the procuring activity at the time of submission of proposals. Approval shall apply only to the specific model proposed.

3.2 Environmental Requirements. The UF shall meet the environmental requirements for a Type II, Class 3, Style D equipment with the deviations specified below.

3.2.1 Temperature and Humidity. The UF shall meet the conditions below:

	<u>Temperature (°C)</u>	<u>Relative Humidity (%)</u>
Operating	10 to 30	95
	30 to 40	75
Non-operating	-40 to 70	Not Controlled

3.2.2 Electromagnetic Compatibility. The electromagnetic compatibility requirements of MIL-T-28800 are limited to the following areas: CE01, CE03, CS01, CS02, CS06, RE01, RE02 (14 kHz to 1 GHz), and RS03.

3.3 Reliability. Type II reliability requirements are as specified in MIL-T-28800.

3.3.1 Calibration Interval. The UF shall have an 85% or greater probability of remaining within tolerances of all specifications at the end of a 12 month period.

3.4 Maintainability. The UF shall meet the Type II maintainability requirements as specified in MIL-T-28800 except the lowest discrete component shall be defined as a replaceable assembly. Certification time shall not exceed 60 minutes.

3.5 Performance Requirements. The UF shall provide the following capability as specified below. Unless otherwise indicated, all specifications shall be met following a 30-minute warm-up period.

3.5.1 General. the UF shall be portable, non-intrusive, transit-time, multiple pulse flowmeter.

3.5.2 Flow. The UF shall meet the following flow requirements.

3.5.2.1 Flow Range. The UF shall measure flow rates from -40 to 40 Feet Per Second (FPS).

3.5.2.2 Flow accuracy. The UF shall have a total system accuracy of +/- 2 percent of the Indicated Value (IV) over the specified flow range when measuring in ideal conditions. Ideal conditions are defined as fully developed flow that may be achieved in laboratory conditions.

3.5.2.3 Flow resolution. The UF shall provide a resolution of 0.01 of the indicated units.

3.5.2.4 Flow measurement repeatability. The UF shall have a system flow measurement repeatability of +/- 0.5 percent IV or better throughout the specified flow range.

3.5.2.5 Flow Linearity. The UF shall have, as a minimum, system linearity of +/- 0.003 FPS under ideal conditions.

3.5.2.6 Flow Profile Compensation. The UF shall compensate for flow profiles with Reynold's numbers of 0 to 10^7 .

3.5.3 Pipe Sizes. The UF shall measure flow rates in pipe sizes of 0.5 to 84 inches Outer Diameter (OD) with a wall thickness of 0.015 to 3 inches.

3.5.4 Pipe Materials. The UF shall measure flow rates in pipes made of any sonically conductive material.

3.5.5 Liquids. The UF shall measure flow rates in any sonically conductive homogeneous liquids of low to moderate aeration.

3.5.5.1 Liquid Temperature. The UF shall be capable of automatically measuring and compensating for test fluid temperature changes over a range of 10 to 40 °C.

3.5.6 Transducers. The UF shall use 5 or less transducers over the specified flow range and pipe sizes.

3.6 Operating Requirements. The UF shall provide the following capabilities.

3.6.1 Front Panel Control Requirements. All modes and functions shall be operable using front panel controls. The locations and labeling of indicators, controls, and switches shall provide for maximum clarity and easily understood operation without reference to tables, charts, or flow diagrams.

3.6.2 Display. The UF shall meet the following display requirements. All the displays shall be easily operated from the front panel.

3.6.2.1 Display units. The UF shall have the capability to selectively display the flow rate in Gallons Per Minute (GPM), Feet Per Second (FPS), and total flow quantity in gallons. All units of flow shall be displayed to an equivalent uncertainty based on the conversion factor for each unit of flow.

3.6.2.2 Display Failure. The UF shall, if the self test of 3.6.3 fails, indicate the nature of the problem and provide directions for diagnostic action.

3.6.3 Self Test. The UF shall determine operational readiness and isolate faulty modules.

3.6.4 Setup. The UF shall be capable of creating, storing and recalling, as a minimum, 16 site setups. The site setup will, as a minimum, consist of a site name, pipe data, liquid data, flow rate units, display information, and output information.

3.6.4.1 Setup Security. A security function shall be provided such that the information put in at the setup cannot be changed without proper numeric code. This function shall be capable of being switched on or off with the proper numeric code.

3.6.5 Installation. The UF shall indicate proper transducer installation instructions. These instructions shall inform the user of proper transducer spacing and size.

3.6.5.1 Installation Check. The UF shall automatically check that the transducer installation is correct. If the installation is not correct, the UF shall display an error message indicating the type of error.

3.6.6 Correction Factor. The UF shall have the capability to input a correction factor that is in percent of indicated flow rate.

3.6.7 Memory. The UF shall have the capability to internally store, as a minimum, 100 flow measurements. The UF shall also be capable of printing the flow data in memory.

3.7 Remote Programming Requirements. All modes, functions, and input/outputs of the UF shall be remotely programmable by means of a handheld computer terminal to be included with the unit. The handheld computer terminal shall be stored on the UF.

3.7.1 Serial Port. The UF shall have a serial port such that a printer may be connected.

3.7.2 Function Output Connections. The UF shall have function output connection capable of energizing a relay.

3.7.3 Displays. Flow information that the user specifies shall be displayed on the handheld computer terminal and the unit itself.

3.7.3.1 Handheld Display. The handheld computer terminal shall be capable of displaying all the diagnostics, setup, and operating information of the UF.

3.8 Manual. At least two copies of an operation and maintenance manual shall be provided. The manual shall meet the requirements of MIL-M-7298.

3.8.1 Calibration Procedure. The manual shall provide a UF calibration procedure in accordance with MIL-M-38793.

3.9 Accessories. The following accessories shall be provided with the UF.

3.9.1 Transducer Cables. All necessary transducer cables in accordance with MIL-T-28800, with a minimum length of 10 feet and marked for upstream and downstream transducers.

3.9.2 Sonic Coupling Compound. Suggested sonic coupling compounds for normal moderate temperature, metal piping applications.

3.9.3 Mounting System. The UF shall provide the necessary mounting system to attach the transducers to the pipe.